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THE GREAT WESTERN RAILWAY.

INTRODUCTORY LETTER OF NICHOLAS WOOD, ESQ.

Killingworth, October 3, 1838.

To the Directors of the Great Western Railway:

GENTLEMEN,—In compliance with your request of the 26th July last, communicated to me by your Secretary (Mr. Saunders,) I have visited and minutely inspected that portion of the works of the Great Western Railway between the London terminus, at Paddington, and the bridge across the Thames, at Maidenhead; and I now beg to submit for your consideration, the progress I have made in that survey, and the additional inquiries and information which appear requisite to fulfil the important task imposed upon me, either with satisfaction to myself, or with advantage to the interests of the great work confided to your management. To place before you more clearly the present state of the inquiry, and the objects requiring further investigation and elucidation, I beg to refer to my instructions for the survey, of which the following is a copy:—

Great Western Railway.

PRINCE STREET, BANK, 4th Sept., 1838.

Sir,—The Directors of the Great Western Railway are desirous of obtaining your assistance in coming to a sound and practical conclusion as to their future proceedings, with which view they have to request that you will undertake an examination of that portion of the line now completed, and investigate the result of the whole system which has been adopted.

Your attention is more particularly to be directed to those points which may be said to constitute the peculiar feature of the Great Western line as contrasted with those other railways, and this will, of course, bring under your consideration the construction and efficiency of the engines, as well as every matter connected with the locomotive department of the Company. The Director will thank you at the same time to give your attention to the bridge over the river Thames, at Maidenhead, for the purpose of communicating your opinion as to the construction of it

generally, as well as to the efficiency of the means proposed to remedy an existing defect in one of the arches.

They will also be glad to receive from you any suggestions or information which you may be able to afford them as to experiments made, and general results obtained on other railways.

I am desired to assure you, that every facility or convenience will be given to enable you to form your judgment in any manner which you may suggest to me, as most conducive to that end.

I am, Sir, your most obedient servant,

CHAS. A. SAUNDERS, Secretary.

Nicholas Wood, Esq., Killingworth.

It is scarcely necessary for me to allude to the very important interests, the immense capital, and the great controversial questions involved in the inquiries comprised within these instructions. Two gentlemen, eminent in their profession, had it appears, been applied to by you to undertake and assist in the inquiry, and had declined; it would have afforded me the greatest satisfaction to have been associated with, and to have had the benefit of these gentlemen's talents and practical experience in the inquiry, and it likewise would have been no trifling consideration to have been relieved from a portion of the responsibility attached to the great and imposing interests connected with the investigation.

In the same degree, however, as I should have been relieved from responsibility, had I had the assistance of these gentlemen, is that responsibility increased by the task being confided to myself alone, and it therefore became of the utmost consequence, that the inquiry should be conducted in such a way, if possible, as that the conclusions should carry with them the confidence of yourselves, that of the Proprietors of the great work entrusted to your management, and also that of the other interests which might be affected by the comparison alluded to in your instructions.

Duly impressed with the importance of these considerations, it appeared to me, there were only two modes by which the inquiry could be conducted, either, that I should have paid a personal visit to the works, minutely examined them in all their features, and relying upon the information thus obtained, to have contrasted this with the existing knowledge which I possessed, or which I could obtain, of the capabilities, powers, &c., of other railways, and to have reported to you my opinion, founded upon these data of the comparative merits of your system as contrasted with that of existing railways constructed in the ordinary manner; that I should institute such inquiries and make such experiments as would fully and decisively develope all the minutiæ, properties, and capabilities of your system; and if the existing information as to others railways did not afford similar conclusive data for comparison, to institute corroborative experiments on other railways; and thus by a comparison of experimental data, practically conducted, to determine the relative capabilities and powers of the two systems in all their bearings.

To have conducted the inquiry according to the former of these modes, however carefully and minutely the inspection had been made, would not have amounted to more than conclusions, founded to a very considerable extent upon individual opinion; and it did not appear to me that any conclusions resting upon such a foundation alone, could either be satisfactory or decisive to yourselves, or to the Proprietors.

It appeared to me, that unless the inquiry was conducted in such a

way as to elicit by incontrovertible and practical experiments, the relative capabilities of the two systems of forming and constructing railways; and that the comparison could be made from these data, it would be of no utility whatever that a survey terminated and founded on mere opinion alone, even if conducted by gentlemen more experienced and capable than myself, would not only be a waste of time, but would be attended with perhaps still worse consequences, viz: that of exciting controversial discussions, with rival interests involved in the question, without furnishing materials for arriving at any satisfactory conclusion.

It was with these impressions, therefore, that after I had consented to undertake the inquiry, I solicited from you permission to conduct the investigation by experimental data; and I cannot withhold my testimony that such a proposition met your ready concurrence, and that in conducting these experiments I have uniformly received all the assistance in your power, and also of those connected with the establishment.

With these observations as to the principle of conducting the inquiry, I shall now proceed to give you in detail the progress I have made, and to point out what, in my opinion, is yet required to solicit the requisite information to enable me to comply with your request to the extent which appears to me really necessary, and to which it ought to be carried, to be productive of practical and useful results.

The system of constructing the Great Western Railway differs from that of the other extensive railways of the country, by the increased width of gauge and in the description and plan of laying the rails, with all the subordinate alterations consequent upon such a departure from the ordinary width of railways.

The increase of gauge has been from 4 feet 8½ inches to 7 feet; and the prominent reasons assigned for such a departure from the common width is, the attainment of a higher rate of speed—increased lateral steadiness to the carriages and engines—a diminution of the friction by the use of wheels of a larger diameter—and a greater space afforded for the works of the locomotive engines.

The deviation from the ordinary mode of constructing the railway has been, the substitution of continuous longitudinal timbers, with piling at certain intervals, and cross transomes; with iron rails of a particular form screwed down upon their longitudinal timbers.

The additional width of gauge has increased the breadth of the entire track of the railway between the outside of the rails of the two lines (including the breadth of the rails) from 16 feet 3 inches to 20 feet 10 inches; consequently all the works connected with the formation of the road will be increased to a certain extent, but not in proportion to the above figures. The plan of continuous wooden timbers and piling also involves an additional cost beyond that of forming railways according to the ordinary method.

The questions submitted to me for consideration, therefore, appear to me to be shortly these—are the advantages professed to be obtained by this departure from the ordinary plan of construction of railways and increased width of gauge, realized? To what extent—at what additional cost—and are the advantages an equivalent for the increased cost of forming the railway according to this plan, viewing the whole subject in connection with the present state of the works?

Acting upon the principles hereinbefore explained as to the mode of conducting the inquiry, it was my object, as much as possible, to subject all, or as many as could be, of the properties of this railway as contrasted

with others, to direct experiment; certain advantages are stated to be derived from this departure from the ordinary width and plan of constructing railways; and the circumstance of 23 miles of this railway having been opened, and having been in operation since the 4th of June, appeared to me to afford an opportunity of subjecting to the test of experience, and of obtaining correct and indisputable results by carefully-conducted experiments, *that which rested on conjecture, or casual observation.*

It is perfectly true, that a daily opportunity has for some time existed of observing the rate of travelling with the passenger trains on your railway, by which some result of the rate of speed accomplished, or likely to be realized when a greater length of line was opened, might be obtained, but the engines on the Great Western differ in many respects from those employed on other railways, and also from each other; if, therefore, extended observations had been made on the rate of travelling, it was necessary to distinguish what was due to the road, and what to the engines—and if any increased speed or greater performance was accomplished, whether such was applicable to the railway itself, or to the particular construction of engine only, and whether, by the application of similar engines to other railways (if practicable,) the same results would not accrue.

If this had been done, no doubt important and valuable information would have been obtained; but that would have been, in fact, the very sort of inquiry, by your own people, which you have determined to entrust to others; and it may be remarked, that if the inquiry had been conducted by yourselves, it could not have been at all conclusive or satisfactory in the comparison with other railways, and without such comparisons it would have been useless.

At the first outset of the inquiry, it therefore appeared to me necessary to institute a set of experiments, to ascertain the actual performances of the locomotive engines upon your own railway; with this information carefully obtained, we then had the real working powers of the railway; by employing heavy loads we obtained correct data for determining the maximum weight which the engines then upon the railway could drag, at determinate rates of speed; and by subjecting the engines to very light weights, we likewise determined the maximum rate of speed with certain known loads; and by recording the quantity of coke consumed and water evaporated in each trip, we also ascertained, with considerable accuracy, the comparative cost of motive power in dragging different loads at different velocities.

Those experiments appeared to me to be highly necessary and valuable, inasmuch as whatever difference of opinion might exist (in the absence of correct experiments to ascertain the fact) as to the friction of the carriages, or resistance of the road, as compared with others, these experiments, by determining the real practicable expense of working the rail-way, would at once ascertain what increased rate of speed could be accomplished, and at what additional cost of motive power such higher rates of speed was attained. These experiments would, in fact, anticipate, so far as the powers of the engines reached, the experience of some years of regular work upon the railway, and with more correct results. On my arrival upon the line on the 17th instant, I therefore commenced a series of experiments on the working powers of the engines, which were continued under my own observation during the ten days I remained there, and are now in operation, and will shortly be completed by persons in whom I have perfect confidence.

It would be premature, to say the least, at this stage of inquiry, to give any results derived from experiments not yet complete; but it may be some gratification to the Proprietors of this great work to state, that one of the engines, the North Star, accomplished an average performance from London to Maidenhead and back, of dragging 180 tons, including engine and tender, at the rate of nearly thirty miles an hour, and that on some occasions for short distances a rate of forty-five miles an hour was attained.

When the powers of the locomotive engines and capabilities of the Great Western Railway are thus obtained, in order to comply with your instructions, and contrast this information with the capabilities of other railways, it will be necessary, in order to arrive at correct and conclusive results, that we should have the result of a similar set of experiments made upon railways of the ordinary construction. Although isolated experiments have been made by different individuals on several railways, and although I have made several myself, it does not appear to me that a set of experiments have yet been made sufficiently extensive and varied to fully develope the capabilities and powers of other railways, so as to form indisputable data for contrasting with the experiments made upon the Great Western. The Directors of the London and Birmingham Railway, in the most liberal manner, grated me full permission to make any experiments on their railway, consistently with the uninterruption of their traffic, and Mr. Robert Stephenson, the Engineer in chief, kindly assisted me all in his power, and furnished me with some experiments he had made on that railway on a former occasion. I deem it my duty, however, to state to you, that I do not think the information I am in possession of is sufficiently extensive or conclusive, as regards other railways, to enable me to make a comparison with the performances of the engines on the Great Western, so as to arrive at an incontestable conclusion; nor do I think it right that I should go into a comparative statement at all, unless the data be equally conclusive or carefully deduced on both sides. The information I at present possess does not enable me to go further than report to you the performances of your engines on the Great Western Railway; and if it be your wish that I should comply fully with your request, and contrast their powers with the performances on other railways, it will be necessary that some experiments, similar to those performed on your railway, should be instituted on some of the ordinary railways of a different width of gauge. It will not be necessary that the experiments on those railways should be equally numerous, as the engines on the other railways are generally of one description, and consequently one or two sets carefully conducted will be sufficient. It may be asked, what practical advantage will result from all these experiments to the interest of the Proprietors of the Great Western railway? The answer is shortly this—it is admitted that the construction of that railway involves an increased capital; it is, therefore, quite necessary to determine what are the additional advantages, in a practical point of view, resulting from this mode of construction, and whether the advantages are greater or less than are equivalent to the increased cost of construction.

These observations apply more particularly to the plan of construction of the Great Western Railway generally, and to the capabilities of the entire system or to the increased gauge, and the mode of construction combined; but it is not necessary to the adoption of an increased gauge, that the railway should be constructed on the plan adopted by Mr. Brunel; it may be constructed on some modified plan of that system, or it might

even be constructed on the plan of the London and Birmingham, or Grand Junction Railways. Neither is it absolutely necessary, if an increased gauge be deemed advisable, that such increased gauge should be precisely seven feet: all these are separate and distinct questions, requiring different and distinct investigation; and, therefore, the simple acquirement of correct information of the comparative capabilities of the Great Western Railway in its present state, with the other existing railways, does not appear to me to comprise the whole question. It appears to me to admit of inquiry whether the width of gauge adopted by Mr. Brunel is or is not that which conduces most to accomplish all the objects for which its departure from the more established width was deemed advisable, and also whether the mode of construction of the railway is the best that can be devised, or in what way it can be improved, consistently with the objects required to be attained, and with due regard to economy.

The plan adopted by Mr Brunel, as previously stated, consists of longitudinal timber bearings, secured by piles at proper distances, with cross transomes, double at the joinings of the longitudinal timbers, and single at the intermediate piles; and upon these continuous bearings, iron rails of a particular form are fastened by screw bolts.

It has been alleged, that one of the objects of the increased gauge was a greater stability to the carriages, and consequently less vibratory; or greater smoothness of motion to the passengers. It appears to be, therefore, one of the subjects of inquiry, how far this is realized—whether such a desideratum is accomplished, and to what extent. Keeping in view the principle set out with in this inquiry, of, if possible, subjecting to experiment mechanically every minutiæ, rather than to rely on opinion, or the more fallacious evidence of our senses, I had constructed an instrument for measuring and recording upon paper all the oscillations or vibrations of the carriages, from one end of the line to the other; and by transferring this instrument to the carriages of the ordinary railways, incontrovertible evidence is obtained, and such as can be appreciated by any one, of the relative vibratory motion of the carriages on the Great Western Railway, compared with the motion on other railways.

We have thus produced a diagram upon paper, showing the number and extent of the vibrations of the carriages—and hence it can not only be ascertained if there does exist less motion on this railway than on other of a less width of gauge, but to what extent; and this is thus made capable of being a subject of arithmetical determination.

It was soon found, however, and this shows the importance of this mode of investigation, that the motion of the carriages on railways was a compound one; that besides a vertical motion, it was composed of an horizontal oscillatory motion, and of a transverse undulatory motion combined; and it appeared, so far as we could depend upon observation, that less of one description of motion existed on the Great Western Railway, and more of the other, than upon the ordinary railways; it therefore became necessary, and of some importance, to measure and determine each of these motions distinct from the other—not merely for idle curiosity, but for the purpose of ascertaining the causes of each—and having done so, to attain the first step towards accomplishing a remedy. All this applies to the compound action of the rails and the carriages; and it will be seen that such a complication of motions required not only time, but extreme labour and attention, to investigate.

We now come to, perhaps, the most important consideratum, that of the construction of the railway; this is, the substitution of longitudinal

continuous bearings of timber, with piling, instead of isolated stone blocks, or transverse timber sleepers, or, indeed, continuous timber bearings, without piling.

The investigation of this part of the subject, according to the principles laid down in this inquiry, was attended with extreme difficulty.

The first subject for investigation was, the relative firmness or solidity of base exhibited by the continuous bearings of timber with piling, and compared with stone blocks, or continuous bearings without piling; to determine this, I had an instrument, or deflectemeter, made, which being placed underneath the rail, measured the amount of deflection when the rails or known weights passed over; and the more accurately to determine the precise action of the load in passing over the rails, I employed three deflectometers at the same time. The motion of one with the other was effected by a rod between each instrument: one was placed underneath each of the supports or transomes opposite the piles, and one in the middle of the rail; and by a similar contrivance to that employed in the instrument for measuring the oscillations of the carriages, I got a tracing of the deflection of the rails recorded upon paper, and thus obtained correct diagrams of the deflection, at each of the places, at the same moment of time.

By subjecting the rails with piling in all their varieties, and also continuous bearings of the same scantling of timber without piling, to the deflectometer, I obtained a measure of the relative firmness or solidity of base of these two varieties of construction; and by likewise employing the same instruments to measure the deflection of the rails and depression of the blocks, or cross sleepers, on other railways; I thus obtained the relative firmness of base of all these different modes of construction; and these diagrams being capable of being transferred to, and embodied in a Report, and measured with undoubted accuracy, will enable any one to pass their own judgment upon the relative firmness of base of those different plans. It will at once, however, be seen, that admitting we have obtained the relative firmness of base of the existing plan of construction of the Great Western Railway compared with that of known plans of construction of other railways; the degree of stiffness developed by the former, comprehends both the section of the timbers, and that of the rails; and that such a plan of continuous bearings either with or without piling, does not necessarily imply the use of that particular form of iron rails. It was, therefore necessary to determine what part of the deflection was due to the timbers, and what to the particular form of rail. To accomplish this, I purpose having these rails removed, and the same rails which were subjected to experiment on other railways, where stone blocks or cross sleepers were used, substituted; when the deflection will be again measured. By a combination of these experiments in all their varieties, I expect to arrive at results which, not being matter of opinion, but facts, deduced from carefully conducted and self-recording experiments, cannot fail of producing the most important, if not conclusive, results.

Independently of those experiments, to elucidate all the minutiæ of action of the different parts of the system of railway mechanism, and others, which it is not necessary at this time to enumerate, I subjected to experiment, so far as the means and circumstances afforded me, the resistance and friction presented by the Great Western Rails to the passage of the carriages and engines along them; and by pursuing a similar course of experiments on other railways, we shall thus have valuable corroborative evidence to that of the experiments made with the engines, of the relative resistance of the Great Western Railway, compared with that of railways of the ordinary width.

With the exception of some experiments on the London and Birmingham railway, made on my survey, and which were not sufficiently varied or sufficiently numerous to afford conclusive results, we still require further evidence of the resistance of the carriages and engines on other railways, to compare with those made on the Great Western Railway, in order to arrive at conclusive results, or indeed to enable me fully to comply with my instructions for this inquiry.

After the previously detailed account of the mode in which I have deemed it necessary to conduct the investigation of the important task entrusted to me, it will scarcely be necessary for me to say, considering the immense interest involved in the inquiry, the time required, and the care requisite to conduct so extensive a course of experiments with a proper regard to accuracy, that there is not sufficient time either for a careful consideration of the subject, or for completing the necessary experiments or investigations, so as to enable me to report to you, previously to the meeting of the Shareholders on the 10th inst.; I regret that a pressure of other business prevented me from applying myself to this inquiry until the middle of last month. Since then the requisite experiments have been unremittingly prosecuted, and are still in operation. To properly digest and arrange so extensive and complicated a course of experiments, comprising so many subjects of inquiry, has occupied considerable time; and when it is further considered, that to properly elucidate and develope experimentally all the various properties of the system, it required instruments to be contrived and constructed during the progress of inquiry, as the different modes of action were developed, it will not be wondered when I say that the inquiry is far short of being so completed, as to enable me to report fully to you in accordance with my instructions.

Notwithstanding all my anxiety and desire to subject to the utmost possible extent all the features of this system to experiment, there will still remain many parts of the duty you have imposed upon me which cannot be subjected to experiment, and on which it will be necessary to exercise the judgment; particularly with regard to the probable cost of working the system permanently, and those parts of the inquiry which experience alone can conclusively determine; in approaching this part of the inquiry, I am desirous of having all the experience which the short period since the opening has afforded, and all the information possible to be obtained. Even if the experiments had been concluded, and even if the question had not been that of a comparison with other railways, I do not think there existed sufficient time between my entering upon the survey, and the period fixed for the meeting of the Shareholders, to enable me to investigate with sufficient minuteness, or consider with sufficient attention the important question of the capabilities of your works alone, so as to report upon them without contrasting them with the capabilities of other systems of railways.

It would, no doubt, shorten the inquiry considerable, were I only required to report upon the capabilities of the Great Western Railway alone, without contrasting it with other railways; but I consider it incumbent on me to state to you distinctly on this head, that such a limitation would preclude me from answering that portion of your request which imposes upon me the task of advising you in arriving at a "sound and practical conclusion as to future proceedings."

It will be necessary, therefore, that you should determine whether the inquiry is to be conducted in the more extended plan, which I have pointed out in this communication, or that it shall be conducted in the more

limited mode of reporting to you the capabilities of your own works; if the latter, the present state of the experiments will enable me, in the course of three or four weeks, to report to you in that limited view; but if the investigation is to be extended to that of a comparison with other railways, in order to arrive at incontrovertible results, it will require a further time before the necessary experiments can be made, and the requisite information obtained to enable me to draw out my report.

Notwithstanding the disappointment which the Shareholders must feel, at not being furnished with the report, for which it appears to have been the object of the meeting on the 10th instant, I feel quite confident that at this stage of the inquiry they will consider it quite imprudent and improper in me to offer any opinion whatever on any of the many important questions submitted to me for investigation. I have approached the inquiry with the utmost determination of impartiality, and of arriving at no conclusions except such as are deduced from facts, or from incontrovertible experiments. It is my intention to embody in my report all the facts and experiments on which any conclusions are founded; and aware of the important interests involved in the comparison proposed to be made between the system of the Great Western and that of other railways, I think it would operate prejudicial to the inquiry if the result of any part of the experiments or investigations, except those already alluded to, should be given, however anxious the Shareholders may be for information.

In arriving at this conclusion, I have been guided by a firm conviction that the interests of the great concern entrusted to your management will not suffer by such a proceeding, or by any delay occasioned by a more minute investigation than the Proprietors probably originally contemplated; for the result of the investigation must be a developement of a more conclusive nature than has yet been elucidated of the system of construction adopted on the Great Western, as well as all the other different plans of construction of railways; which cannot fail of being productive of considerable advantage not only to your interests, but also to those of every one connected with that system of internal communication.

I am, Gentlemen, your obedient Servant,

(Signed) NICHOLAS WOOD.

Report of John Hawkshaw, Esq.

To the Directors of the Great Western Railway:

GENTLEMEN,—Your instructions of the 5th September are to the following effect:—That you are desirous of obtaining my assistance in coming to a sound and practical conclusion as to your future proceedings, directing my attention to those points which may be said to constitute the peculiar features of your railway, as contrasted with others, including the construction and efficiency of your engines, as well as every matter connected with the locomotive department.

My attention is also called to the bridge at Maidenhead, as to its construction generally, and as to the means proposed to remedy an existing defect in one of the arches. To arrive at an opinion, I am desired to undertake an examination of that portion of the line now completed, and investigate the result of the whole system which has been adopted.

To come to a proper conclusion, it appeared to me to be necessary that I should make myself acquainted with the general character of the whole line, and consequently I have been over its whole length to Bristol. It

seemed also desirable that I should inform myself, as accurately as possible, as to the traffic to be expected upon it, generally, and in the aggregate, for this certainly forms one of the most essential features of all lines.

The question seems also to require a still more extended view than this; the district into which it goes has to be glanced at; the area and extent of population, which may be looked to for collateral traffic, has to be seen; and these have to be compared with districts through which other lines have been made, and where other lines are at work.

The necessity for such a view of the question became apparent to me, because, on coming first upon your road, that which immediately strikes is, the enlarged capacity of all things, engines, carriages, and road. And the existence of such an arrangement pre-supposes, in my view, an equally enlarged traffic; trains of much greater weight, and of a greater number of passengers than elsewhere. In short, though not to an equal degree, the difference between your arrangements, and those of other railway companies, is something like the difference between a canal for barges and a canal for ships; and this comparison will not be extraordinary, should it appear, that taking your gradients into the question, your locomotives have twice the power of those on other lines; and the contrast will not have been useless, should it be shown, that it would be a parallel case to build a ship of 200 tons burthen, when there was no probability of ever obtaining cargo of half the weight.

Further, I may extend these preliminary remarks, by observing, that the object which I presume you have in view is, (after paying a due regard to the accommodation and convenience of the public,) to carry out your measure in such a manner, as shall be most conducive to the interests of those who have invested their property in it. That this should be your object there can be no doubt, and I wish to place it here as *the desideratum*, because it is one thing to design that which shall be pleasing in outline, and grand in dimensions; and it is altogether another thing to design that which under all the circumstances shall best answer the end in view; one of those ends being to obtain a return for the capital invested.

I am desirous that it should not be thought that I am here prejudging the question. To all questions there are conditions, and I only wish it to be clearly understood what are the conditions of the question, which, as I understand it, this report professes to consider. And they may be repeated; that in carrying out the measure, there is to be *the fullest regard to the wants and conveniences of the public;* but also a constant regard to the prospects and expectations of the Shareholders.

Now, it will not be difficult to show, that the legitimate interest of these two parties are one.

The profits of a railway are determined by the ratio of the proceeds to the cost; if the latter be greatly increased, it becomes almost imperative on the proprietary to increase the former; either by curtailing the accommodation, or by increasing the charge to the public. The public, therefore, is interested as much in the economy of railroads, as in the economy of manufactures; in the one case, if it be in fabrics, it will cause a reduction of the price per yard; in the other case, it will cause a reduction in the rate per mile. And if the public, in the extended sense of the word, is to be benefitted by economy being exercised in the construction of a railway, the public, in a more limited sense of the word, or the more immediate district through which the line passes, will derive still greater advantage.

Suppose for instance, that the problem to be solved was, to give the greatest impetus to the trade, and the greatest advantage to the town of Bristol. The way to solve this problem, I think, would be, to connect it with the Metropolis by a road on which parties could be carried for the smallest sum, and at a velocity not inferior to that at which they can be carried in any other direction. Now the cost at which a party can be carried will be, as the interest on the *capital expended*, added to the cost of working the road.

For instance, call the gross revenue of a road paying 10 per cent., 100; and call the cost of working 50 per cent.; 50 will then be left to pay 10 per cent.

The capital ought not to be doubled advisedly, therefore, unless one of these two things is to be accomplished by it; either that the cost of working be reduced to nothing, or that the gross proceeds be doubled. Should the capital be increased without affecting any material reduction in the cost of working, the consequence will be, that, to increase the proceeds, the rates must be raised; and this may or may not be effectual; for an increase of charge beyond a certain limit will not increase the proceeds. If it should not be effectual, the Shareholders will suffer. If it should be effectual, the public will suffer, by having to pay the higher rates.

If, supposing in the case of a railway only partially constructed, it should turn out that the traffic has been as much under-rated, as the cost of the line had been increased, and that still a profit of 10 per cent. will accrue; yet it proves only this, that though in one case, by good fortune, a profit of 10 per cent. will be obtained; in the other case a profit of 20 per cent. would have been secured.

It would not apply this species of illustration to cases where the cost is increased of *necessity;* I would only apply it to cases where the increased expenditure is for some *specific object;* such as the attainment of much flatter gradients, or of very high velocities, or of much greater dimensions; which may, or may not be desirable, according to the result when tried by this rule.

Now supposing this species of test be applied to one great object which you appear to have in view; the reduction of a great portion of your line to a practical level, for the ostensible purpose of obtaining higher velocities, or diminished resistance.

Between your maximum parliamentary gradient, which was 1 in 528, or 10 feet per mile, and your present proposed gradient, which is 1 in 1320, or only 4 feet in a mile, the question stands thus:—

Calling friction, resistance from the atmosphere, &c., 10·2lbs. per ton, and adding gravity, the resistance on 1 in 528 will be 14·2lbs. per ton, on 1 in 1320 it will be 11·7lbs. per ton, making a diminution of resistance, when ascending, of 17 per cent. Now, supposing your railway was one inclination throughout between the extreme termini A and B; in rising from A to B the increased resistance of 17 per cent. would be felt, and a corresponding increase of steam would have to be expended; but in descending from B to A there would be a diminished resistance in the same proportion, and a smaller quantity of steam would be required; and in such a case, as it regards *cost* of working, there would be very little advantage in one gradient over the other. The maximum load that an engine could draw on an incline of 1 in 528, would be less than on 1 in 1320; but on an incline of 1 in 528 all average loads could be taken.

On an incline of 1 in 528 also, to carry *the same load*, an engine would

have to be a trifle heavier than on 1 in 1320; but on 1 in 528, to carry full average loads, an engine could be made of as light weight as they ever are, or perhaps can be made, consistent with the requisite strength.

If, instead of having one inclination, the line consisted of a series of inclinations greatly undulating, the advantages of the flatter line would approach nearer to 17 per cent.; not but that it would still follow, that in going up the steeper gradients there would be increased resistance, and in gowing down there would be diminished resistance in equal proportion; yet in practice it has been found, that unless the inclines be of very great length, advantage cannot be taken of the diminished resistance in going down as regards *steam;* for though it is not wanted to an equal extent, yet a great portion is wasted by blowing off at the safety valve.

But your line corresponds to neither the latter nor the former of these cases; it is neither composed entirely of one plane, nor of a series of planes *greatly undulating;* but, in result, it will approach nearer to the former case than the latter; for it may be said to be composed of two great planes, one rising up to the summit, the other descending from it; one upwards of 70 miles in length, the other upwards of 40; and dividing your line at the summit into two parts, it would then be analagous to the former case; in which it appears that practically, and as regards cost of working, there would be no very material difference between the inclination of 1 in 528, and of 1 in 1320, *when so circumstanced.* If in your line, therefore, the advantage of one gradient over the other be put at 8·5 per cent., it will, in my opinion, be the *full* equivalent.

Now, if the whole cost of working a railway was expended on locomotive power, by reducing the gradient from 1 in 528 to 1 in 1320, a saving of 8·5 per cent. would be effected; and therefore an increase of 8·5 per cent. to the capital to obtain it, would not be expended uselessly.

But the expense of working railways does not consist entirely of the cost of locomotive power. There are other expenses that remain constant, whatever saving be effected in the locomotive department; and this fact should be kept constantly in view during the remainder of this report.

Taking the Liverpool and Manchester Railway as a standard, it will there be seen that the cost of power does not form one-third of their half-yearly expenses. It is upon this item only, therefore, that an alteration of the gradients of the nature I have been describing would effect a saving of 8·5 per cent.; and 8·5 per cent. upon one-third of the annual expenses, will be only 2·8 per cent. on the whole of the annual expenses; and therefore a company would do wrong in increasing their capital more than 2·8 per cent. to effect such an alteration.

But the small saving to be obtained in many cases by reducing gradients below a certain inclination, may be proved by an appeal to actual practice; not experiment only, but the every-day results of lines in operation, which is far better; for it is upon the every day business that the saving must be effected, if it is to be.

Contrasting your line with one which opened about the same time, which also has continuous bearings; upon which an equal velocity has been maintained, and which, as will appear from the statement below, has very different gradients, it will be seen, that in a case like yours I have put the advantage of a gradient of 1 in 1320 over 1 in 528, high enough.

Gradients on Great Western.

Miles.	Chains.			
"	16	level		
2	1	rises	1	in 1760
7	43	"	1	in 1320
"	40	"	level	
2	48	falls	1	" 1760
"	40	"	1	" 1320
1	72	"	level	
"	30	falls	1	" 1980
1	40	"	1	" 1320
"	20	"	1	" 4640
1	40	rises	1	" 2640
1	"	"	1	" 2112
"	20	"	1	" 1320
"	30	"	1	" 1980
2	"	"	1	" 1320

Gradients on Manchester and Bolton Railway.

Miles.	Chains.			
"	10	level		
"	26	1	falls	in 1312
"	28	1	rises	" 160
"	16	level		1034
"	35	1	rises	" 1834
1	50	1	"	" 544
4	61	1	"	" 200
1	32	1	"	" 274½
"	62	level	"	

The following are the results of four weeks' traffic on each of these Lines, ending the 13th September.

Great Western Railway.

Average number of trains per day	14
On Sundays	12
Times of running	8, 9, 10, 12, 4, 5, 6, 7
Average number of carriages per train	6 . 5
Average number of passengers per train	111
	Tons. cwt.
Average weight per train	40 5
	lbs.
Average consumption of coke per mile	51 . 00
Average consumption of coke per ton per mile	1 . 26
Average consumption of coke per passenger per mile	0 . 45
Length of trip	22½ miles

Average time, 55 minutes, with two stoppages.

Manchester and Bolton Railway.

Average number of trains per day	20
On Sundays	4
Times of running	7, 8, 9, 10, 12, 2½, 4, 5, 6, 7
Average number of carriages per train	6

Average number of passengers per train		72
	Tons.	cwt.
Average weight per train	24	1
	lbs.	
Average consumption of coke per mile	27 .	00
Average consumption of coke per ton per mile	1 .	16
Average consumption of coke per passenger per mile	0 .	36
Length of trip	10 miles	
Average time of making it, without stoppages	27 minutes	

Average time, 35 minutes, with 5 stoppages.

From the foregoing statement, it would appear that the consumption of coke is considerably less on the line with steep gradients. But the average weight per train is in each case exclusive of the engine and tender.

The average weight of engine and tender, in working order, on the Great Western Railway, will be 27 tons.

On the Manchester and Bolton Railway, the engine and tender, in working order, weigh 16 tons 4 cwt.

Adding these to the respective trains, the average weight of the Great Western train, including engine and tender, will be 67 tons 5 cwt.

The average weight of the Manchester and Bolton train, including engine and tender, is 40 tons 5 cwt.; and

Consumption of coke per ton per mile on the Great Western, including weight of engine and tender, is 0.75 lbs.

Consumption of coke per ton per mile on the Manchester and Bolton, including weight of engine and tender, is 0.67 lbs.

And on the Leeds and Selby Railway, with the following gradients, the results of a month's working, ending 13th September, are as under:—

Gradients.

1½	Miles	rises	1	in	210	3	Miles	falls	1	in	135
1	"	"	1	"	176	3	"	"	1	"	152
2	"	"	1	"	852	6½	"		level		
3	"	"	level								

Average number of trains per day, 7—2 on Sundays.
One train extra on two market-days per week.

Average number of passengers per train		57
	Tons.	cwt.
Average weight per train, exclusive of engine and tender	32	5
Average consumption of coke per mile	36 . 00 lbs.	
Average consumption of coke per ton per mile	1 . 1 lb.	
Average consumption of coke per passenger per mile	0 . 63 lbs.	
Length of trip	20 miles.	

Average time 1 hour 7 minutes, with four stopages.

The next subject for consideration is the increase of gauge. In examining this question, it will be necessary to put aside useless and erroneous objections; for the enquiry is one on which I am not only anxious to arrive at a proper conclusion myself, but I am desirous of enabling others to do so also: and throughout this Report I shall rather aim at developing the process by which the opinions it contains are arrived at, even at the risk of being tedious, and aware, though I am, that this will be laying it more peculiarly open to any who should be disposed to cavil at it; yet, on such a subject, it is better that it should partake more of the nature of demonstration than of mere assertion.

It may be observed here, that much that is absurd has been applied to the question of gauge: some have looked for advantages so great as would have left them little less than magical; they seem almost to have expected that on *such a gauge* the carriages would run of themselves. Others, on the contrary, seem almost to have expected that on such a guage carriages could never be made to run at all. It has been applauded to the skies as being wonderful; it has been decried, and cried down, as being little less than nonsensical. Now, it is neither the one nor the other of these; it is simply a railroad of greater dimensions than those hitherto constructed, and the only question is, is such an increase of dimensions judicious or not? And the next question will be, if injudicious, considering the amount in money to which you are committed to it, is it better for you to proceed or to make the alteration?

In the first place it may be stated, for there can be no doubt about it, that just as good a road can be made 7 feet wide as 5 feet wide; it is simply a question of cost. There are some, no doubt, who have connected the effects of the malformation of your road in the first instance, with the width of way, but of course eroneously so.

In the next place, in determining on the question of gauge, it should be considered quite independently of anything that may have been done upon your railway, which is not absolutely consequent on the increase of gauge; and I shall class among the non-essentials the peculiar mode of laying with piles, engines of 16 tons weight, and tunnels of 30 feet diameter.

It may be premised that determining the question of gauge in this country, is a very different question from determining it with regard to countries where the railway system is scarcely introduced. In England, what may be termed the great trunk, connecting the north with the south, has already been formed, or is in progress. Under the superintendence of men who were earliest connected with the Liverpool and Manchester railway, and with railways even prior to that, it has been constructed on a gauge of 4 feet 8½ inches. They had had more experience than others in railway matters; and their continuing the same dimensions as to width of way proves that they had found no occasion for altering it. Moreover, it is indisputably true, that they who have had the most experience, and who have been brought most into contact with the working of railways, see the least occasion for an alteration as to width, and are the most satisfied with the present gauge.

In addition to this main trunk, another line crossing it at right angles, and of which the Liverpool and Manchester, and the Leeds and Selby railways form a part, and which will connect the eastern with the western seas, is already constructed, or in progress, to a similar gauge; and other lines of great extent, some of them surrounding and piercing into the district into which your railway goes, are also formed, or are rapidly forming to the 4 feet 8½ inch gauge.

And it will not be too much perhaps to say, that three-fourths of England is already being traversed by railways to the narrower gauge.

It follows, then, that any Company deviating from this gauge will be isolating themselves to a certain extent; if not as regards their main line, yet as regards their branches; if not as regards their direct traffic, yet certainly as regards their collateral traffic.

But, in the present early stage of railway traffic, it yet remains to be seen whether or not it may not become a great evil for a main line to be thus isolated and rendered impossible of connection with the great lines in its neighborhood; that it will be an evil in this sense as it regards the branch

lines, there can be little doubt; for they or some of them, in course of time, will of necessity run into the neighbourhood of other lines of different gauge; but with these, however vital the connection may be, all connection will be impossible.

In this point of view only, it has become a serious matter for any Company in this country to make their line to differ as to dimensions from the majority of lines around them. It is to a certain extent as if a Canal Company in a country of canals should construct a new navigation so, and with locks of such a character as would totally shut out the boats of all the canals that surround it.

Still it is possible that there might be, coupled with the deviation, improvements of such a nature as would counterbalance the inconvenience, as would even compensate the loss. They might consist of arrangements that would effect a *great and important saving in time and money*, and in a better conservation of the property to be conveyed: and it will be necessary to enquire if such will be the result of the deviation in your case as to the width of way.

If the 7 feet gauge is to effect a saving in money, it must be in one of two ways; either by calling for less capital in the first instance, or by reducing the cost of working afterwards. The first of these it cannot do. On the contrary, the capital will be increased certainly: to how great an extent it would be impossible for me without more time for calculation to say. But contracting the dimensions to the smallest limit; two ways of 7 feet must of necessity require a greater width than two ways of 4 feet 8½ inches. I should say to make a line equally as convenient, this increase of width would amount to 4 feet; for the width between the ways is not to be governed entirely by the maximum width assigned to the load. A certain width is found convenient for repairs and other purposes; and too great a proximity of the ways is dangerous; as by it an accident occurring on one line may be productive of disastrous consequences on the other, as I have seen. And the width outside the ways will also be nearly a fixed quantity whatever be the gauge; for a certain width is requisite for safety, and for allowing proper consolidation to the outer rail on the embankments, and to give room for drainage in the cuttings; and, therefore, the width of the road generally, to make as convenient a road, would have to be increased by the extra width given to the ways. And besides this increase of general dimensions as to earth work and land, the locomotives would of necessity have to be heavier, (I do not say to an equal extent to those you now have), and they would therefore be more costly to some extent. The permanent road will also cost more of the larger dimensions than if of the smaller; for it avails nothing to compare a light rail on the larger gauge, with a heavier rail on the smaller gauge! such comparisons must be made when other things are the same, or they amount to nothing.

If then the capital will of necessity be increased, the next enquiry is, will the cost of working be diminished? The cost of working will depend on the first cost of the engines; for though, in the first instance, they may be charged to capital, afterwards they will have to be charged to current expences. It will also depend on the repairs of the engines, the consumption of coke, and the maintenance of way; and on other matters which are in nowise connected with the gauge.

As it regards the cost of the engines, it will be greater on the wide gauge; as it respects the repairs of the engines, should it prove in favor of the wide gauge, it can only be in a small degree. For the repairs of locomotives on lines where passengers are carried at great velocities, have been found

to be incurred chiefly on the wheels and axles, tubes and fire boxes, which cannot be affected by the gauge, excepting that if the wheels and axles be made larger, the repairs will be increased. And, at all events, the common repairs of a larger machine, necessarily so, in consequence of the larger way, but not necessarily so in consequence of any greater traffic, it is probable, will counterbalance any saving that might be effected in the repairs of the smaller gearing, in consequence of having more room to arrange it. Besides, a great portion of the repairs of locomotives is not for common wear and tear, but is on account of accidents. And in proportion as the machine is made larger and more expensive, so will the cost of repairs consequent on accidents be increased.

The maintenance of way will of course be *fully* as great on a wider way, and with heavier engines, as on a narrower way, with lighter engines; for perhaps it would not be advancing too much to say, that the engines and tenders do more harm to the superstructure of railways than all the rest of the traffic put together; excepting perhaps loads of long timber.

And, lastly, if the consumption of coke is to be reduced on the wider gauge, it can only be by the friction being diminished, or by what has been called the mechanical advantage of large wheels.

It would have been highly desirable if, before using this as an argument, the Irish Commissioners had clearly determined that there was an advantage in larger wheels. For there are some experiments and several reasons for doubting that any such advantage will be derived from increasing the size of wheel. As it regards the friction of attrition, or that caused by the rubbing of the axles, it may be supposed to remain constant, however the wheel be enlarged; if it be allowed that with an enlarged diameter of wheel, and especially when attached to a longer axle, there must be a corresponding enlargement of journal; and in practice I think this would be the case. And as regards the friction of rolling, it is not likely to be diminished by increasing the size of the wheel, for the rolling friction on rails is very different from the rolling friction on common roads, where obstacles are met with that have to be surmounted by raising the vehicle over them. Small wheels on turnpike roads have been found to create much more resistance. But on a railway, unless the wheels be very small, the obstacles to motion from causes of this nature must be nearly imperceptible. And there is another species of rolling friction, caused by the grinding of the flanges of the wheels against the rails, which will be more felt in large wheels than in small wheels, and especially round curves.

But to arrive at something more definite on this subject. I will give the result of some experiments made on your line on the 20th September.

A large train, consisting of 9 carriages, 1 six-wheeled waggon, and 11 trucks, laden with iron and stone, was got into motion up and down a long and perfectly straight inclination of 4 feet per mile. The experiment was first made upon the whole train, which gave a result of 6.22lbs. per ton friction.

The experiment was then made so as to ascertain the friction of the trucks and the carriages separately, one truck only being left attached to the carriages, and the result obtained was a friction of 6.5lbs. per ton for the trucks and waggons, which weighed together 79 tons 8 cwt.; and a friction of 8.15lbs. per ton on the carriages and one truck alone, which weighed in the aggregate 74 tons 12 cwt.

On the 26th September, I took 5 waggons on the Manchester and Bolton railway, each laden with 3¼ tons of iron, and experimented in the same way upon them, by getting them into motion, and noting the velocity and the

distance run, from which the friction was determined to be 6.3lbs. per ton. The plane on which this experiment was made was terminated at each end by curves, one of 111 chains radius, the other of 67 chains radius. In the experiment up the plane the distance run was 2950 feet, the waggons having run 330 feet into the curve of 111 chains radius before they stopped. In the experiment down the plane the distance run was 3825 feet, 1980 feet of which was in the curve of 72 chains radius in which the waggons stopped. The same train of six waggons was then brought to an inclination where gravity alone was sufficient to get it into motion. This portion of the line had previously been divided by stakes into lengths of 100 feet, and the rails opposite each stake accurately levelled.

From the starting point to the ninth stake the line was straight, but at this point a curve of 42 chains radius commenced, and extended beyond the point where the waggons came to rest.

The result of this experiment, repeated twice, gave a friction of 7 32lbs. per ton; but it should also be observed that besides passing for 1300 feet along a curve of about $\frac{1}{2}$ a mile radius, the whole distance run being about 2200 feet, the train had to pass through three shunts before coming to rest, which will probably account for the friction being higher than in the previous experiments.

This line, as well as the Great Western, has continuous bearings of wood. Though for a short distance in the curves in all the experiments on the Manchester and Bolton railway, the motion was continued on continuous bearings of stone. The Manchester and Bolton line has a heavier rail of (53lbs. per yard).—And in the Great Western experiments, 3 of the carriages and 1 waggon had 6 wheels each, which have rather more friction than those of 4 wheels; but in such a large and heavy train, no great difference could be caused by this.

The whole of the wheels in the Great Western experiments were 4 feet in diameter, the journals 2 11-16 inches in diameter. In the experiments on the Manchester and Bolton railway the wheels were of 3 feet diameter, and the journals of 2 inches diameter: and 4 feet: 3 feet:: 211-16 inches: 21-16 or 2 inches nearly. But supposing that neither the foregoing experiments nor reasonings are to be decisive as to the mechanical advantage of increasing the size of the wheels, and I do not mean to say that they are, for to determine the question clearly the experiments should perhaps be made on the same road; yet still as a general question there will be several drawbacks on the theoretical advantage of the larger wheel, such as the greater resistance on curves with the wider way; more rubbing of the flanges against the rails, not only in consequence of the larger wheel, but of the greater breadth of way; for I think it is probable that friction would be reduced to a minimum by concentrating the whole momentum of one rail, and that friction will be increased in some train degree, as the distance between the wheels, or as the width of way is enlarged.

The next inquiry respecting the gauge is as to the matter of safety. If the gauge is to be altered on this account, it should only be because of a want of safety in the present gauge. If A be safe, there cannot be the smallest advantage in making B safer.

Now the question is, is the narrower gauge safe? It might have been reasoned a *priori* that the width between the railway wheels being equal to those of turnpike-road carriages, and from the very great weight of railway wheels and the under carriages, the centre of gravity being in all cases much lower on a railway coach than on a stage coach; and the railway itself being infinitely more smooth and perfect than the common road; that

though the velocities are much greater, yet still there is no danger of overturning. And the fact is, I have never heard of a case of overturning, or of any accident that I should attribute to the narrowness of base, occurring. And from what experience I have had on railways, I believe it would be a most difficult matter to overturn the carriages upon them, with the present gauge, even if the object was purposely to do so, and an experiment should be made for the purpose. But having heard it urged, that there was greater safety on the wider base, which may be granted, but which amounts to little if there is quite enough of safety on the narrower base; and being unable to call to mind a single instance of an accident or overturning in consequence of a narrower base, I addressed a letter to Mr Booth, the Treasurer of the Liverpool and Manchester Railway on the subject, to know if he had ever known an accident that could be attributed to the narrowness of base; I also wrote a similar letter to Mr. Smith, Engineer on the Leeds and Selby Railway, and I received the following replies:—

"*Liverpool and Manchester Railway, Lime-street Station,*
21st Sept. 1838.

"Sir,—I have to acknowledge the favor of your communication of the "19th, inquiring whether or not, in my experience, there is any want of "safety in the present gauge, 4 feet 8½ inches, as to the chance of overturning; and also if I have known any case of overturning in consequence of "narrowness of base, or am aware of any accidents having occurred, which "I would ascribe to the the narrowness of the 4 feet 8½ inches base.

"In reply, I beg leave to inform you, that in my opinion there is not any "want of safety in the 4 feet 8½ inch gauge, and I am not aware of any "accidents having occured that I should ascribe to the 4 feet 8½ inch "gauge. The only case of overturning which I recollect occurred some "years ago, when, owing to the breaking of an axle, the engine (which "had only four wheels,) quitted the rails, and drew several of the carriages "over the embankment, near Bury-lane.

"Whether in such a case a broader base would have prevented the "carriages overturning, I will not pretend to say; it might depend on the "relative height of the carriages, and other circumstanees.

"I am, Sir, &c.,

(Signed) "Henry Booth.

"John Hawkshaw, Esq."

Leeds, 21st Sept., 1838.

"Dear Sir,—In reply to yours of the 19th inst., we have had but one "accident (during the experience of four years) that was not occasioned "either by tongues being wrong or some obstacles in the way. The one "excepted, was caused by the repairers raising some wood sleepers too "much at once on a new-made embankment. I do not consider there is "any want of safety in the gauge, (4 feet 8½ inches,) nor do I know of any "accident or overturning which can be attributed to that gauge.

"I am, dear Sir, yours, &c.,

(Signed) "Geo. Smith, R. E.,
"Leeds and Selby Railway.

"John Hawkshaw, Esq."

Besides there is no difficulty in lowering the centre of gravity on the present gauge very considerably, were such a thing desirable or called for. For by making the coaches omnibus fashion, the passengers in each coach could be made to sit a foot lower than at present. That this is not

done goes a great way to prove that it is unnecessary. Or by keeping the centre of gravity as it is, it is quite easy and practicable with the present gauge to increase the size of the wheels from 3 feet to 3 feet 6 inches, or larger, if any thing was to be gained by it.

Having gone into question of gauge abstractedly from what has been done upon your line in connection with it, and debiting the system of a 7 feet rail with such an increase of cost only as appears to me to be absolutely consequent on its adoption, I feel compelled to come to the conclusion, that there are no advantages to be obtained by adopting it, at all commensurate with the evils that will be consequent on the deviation; and for the reasons which follow, it is not desirable in my opinion to proceed with it, unless you were already committed to it in a pecuniary sense, to an amount that will outweigh all the objections to it, but which will be seen hereafter.

The additional reasons for not proceeding with it are these:—first, considering the great cost and the comparatively small profits of railway lines generally on the smallest dimensions, and the great difficulty there is, and the corresponding increase of outlay that is incurred, in obtaining curves of sufficiently large radius to be workable at the present narrower gauge; I cannot conceive that there is a single practical man in England who could recommend the 7 feet gauge as a general system for this country.

If unfit as a general system for the whole country, it will be unfit as a partial system for a portion of it; unless that system is of necessity to be very much confined; its ramifications into other districts impossible from natural barriers, such as seas, or lakes; and the nature of the country, such as to undulations, that the cost of obtaining curves of larger radius will be trifling.

Even admitting that the latter condition is true of your line, and that from its general flatness curves can easily be obtained of large radius, yet this cannot be predicated of the whole of the branches and extensions to which you will have to look for collateral and extended traffic. And even if it could, still the system is unquestionably more expensive to some degree, and though you with your large traffic *might not* be totally crushed by it, it has yet to be seen what the effect will be on smaller and less favourable lines; which, to get into yours, will be compelled to adopt similar dimensions, and involving of course similar expenses. At the same time, the prosperity of your line will be affected in no small degree by the prosperity of the tributaries to it; and, in fact, a probable result of doing things on such a great scale will be to drive traffic, which otherwise would come upon you, in some other direction. For in railway lines generally, in the same country, there will come to be a mutual dependance one upon another. And surely it must be rather an untenable doctrine to hold, that the gauge of each line is to be determined only by reference to its curves and gradients, for by such a rule it would follow that no two lines could be alike.

Finally, it may be said of railway lines, that they will not bear any additional expense. It may perhaps be said of every railway formed in this kingdom, that if the company had to begin again, their object would be to economise, and to diminish their first outlay, not to increase it; or if there be a railway company, and such are rare cases, that has already devoted its attention to the utmost in keeping down the expenditure in the first instance, that railway company would not do otherwise if it had to begin again; and that railway company will feel that for the course that has been pursued there is every cause for congratulation.

I could not advise you to take the London and Birmingham as your model, and feel satisfied if you exceed them as to cost in only a few particulars; their line was necessarily through a country very different, and far more expensive than yours; and their line is in a position in which, if a great expenditure is to be repaid any where in this country, it will be to them. For I cannot conceive that your line that I am acquainted with can expect an equal amount of *thorough* traffic; for into their line a great portion of the north of England, and a still larger portion of Scotland, besides the great manufacturing and commercial districts of Birmingham, Manchester, and Liverpool, must of necessity converge before arriving at the Metropolis.

Still, though I do not see that the aggregate of your traffic can ever be expected to equal that of the London and Birmingham; yet, considering the *much more favorable* country through which your railway passes, and that the traffic upon it will be unquestionably very large, I think your line presented equally as good features for investment, and perhaps may do so still; it will depend, in my view, upon the course you pursue.

That course as far as my opinion goes, is not to go forward on your present system. Knowing that railways hitherto, and on the smaller scale, have been found greatly expensive, so much so, as scarcely in any case to leave an ample dividend, when the great risk of such investments is considered, I cannot advise you to proceed on a plan which, in all human probability, will materially diminish that dividend.

It cannot be necessary for the attainment of safety, when in the present gauge their is no danger.

It cannot be required for the attainment of high velocities, because on the narrower gauge velocities can be attained with perfect safety, greater than could be maintained by any railway company in England perhaps, without absolute ruin to themselves in a pecuniary sense.

The Liverpool and Manchester Railway, by increasing their speed from 20 to 26 miles per hour, have increased their locomotive expenses about 15 per cent. Much higher velocities than this are attained, and with perfect safety, on the narrower gauge; but there is no company that could bear the increased expense of maintaining such velocities constantly, or if there be, it will be found to be that company which has expended the least in the first instance. For example; the Grand Junction would feel the effects of increased expenditure to maintain a very high velocity, less than would the London and Birmingham; not that their gradients are better, they are worse; but simply because their first outlay is much less, and therefore their annual expenses might be much increased, and still leave as large a revenue: in short, for very much the same reason that 21s. for carrying a passenger 97½ miles on their line, will probably pay them quite as well as 30s. will pay the London and Birmingham company for carrying a passenger 111 miles on their line.

But in advising you not to proceed in constructing your line on the larger scale, it is necessary to take a review of the consequences.

You are, to a certain extent, committed to it in a pecuniary sense. This amount can be ascertained and contrasted with the saving to be effected by contracting the *dimensions*, if there be a saving; if there be no saving as to first cost, in making the alteration, yet as I believe there would be a material saving in the expenses afterwards, and other advantages of greater magnitude still, such as the avoiding the introduction of an expensive system into districts which can ill afford it, the consequent re action from

which would be felt by your own line, I feel bound to recommend you to make the alteration.

That which will go to the debit of making the alteration will be as follows:

22 Miles of road to be taken up and re-laid, the same materials being used, £1,500 per mile				£33,000	0 0
14 Locomotives & tenders received (adapted for wide gauge) £1980 each	£27,720	0	0		
7 Engines and tenders, constructing, say same price	13,860	0	0		
42 First-class carriages at £544	22,848	0	0		
40 Second-class carriages at £351	14,040	0	0		
118 Trucks and waggons at £106	12,508	0	0		
				90,976	0 0
				£123,976	0 0

On the rails, I do not consider there would be any loss, for though I think them too light, yet they will be much less objectionable in this respect on the narrower way.

That which will go to the *credit* of making the alteration will be as follows:—

£1000 per mile to be saved on 100 miles of permanent way yet to be laid	£100,000	0 0
£400 each less upon 60 engines and tenders yet to be obtained to make full stock	24,000	0 0
£200 per mile less on earthwork, &c., yet to be completed, say 60 miles	12,000	0 0
Say 20 per cent. on tunnelling yet to be done, by the narrower gauge, requiring 4 feet less width, say 2000 yards at £10	20,000	0 0
	£156,000	0 0

It is useless to push this inquiry further. It is clear that even considering the question as if your present stock of engines, carriages, &c. would be valueless, if you alter the gauge; and contrasting this loss with the saving that would be effected by adopting the narrower gauge, supposing that in prosecuting the 7 feet gauge you were only in future to do that which is barely necessary, still, taking such a view of it, the advantage in a pecuniary sense is decidedly in favour of an alteration of the gauge.

But if the comparison were made on the supposition that in carrying out your system as to gauge, you were to continue the large dimensions you have begun with, the pecuniary advantages in favour of reducing the gauge would be very much greater.

Further, there is no necessity for considering all your present stock of engines and carriages as valueless: for supposing you should decide upon altering the gauge, it could be done as follows.

It would be necessary in the first place to curtail the dimensions of all the works yet remaining to be done, and to proceed with taking up one of the lines between London and Maidenhead, and to relay it to the narrower gauge. In the mean time your present traffic in passengers could be carried on very well on one line. On the Railway between Antwerp and Brussels, greater numbers are carried on a single line of way. This would of course afford employment for your present stock of engines and carriages for probably a year and a half, and would therefore go to dimin-

ish the sacrifice that ultimately would have to be made; that sacrifice would be still further diminished, by the value of such part of the carriages, trucks, and engines, as could be applied in the construction of others for the narrower gauge.

Of course the traffic would have to be transferred to the line of narrower gauge before the second seven feet way between London and Maidenhead could be taken up; it might then be relaid to the narrower gauge, and could be got ready by the time that an extended portion of your line should be prepared for opening.

Having come to a conclusion that so great an increase of gauge as to 7 feet is to be avoided; the question will arise, is 4 feet $8\frac{1}{2}$ inch exactly the thing? No one, perhaps, will pretend to say that it is so precisely, or that an inch or two in addition could make much difference as to cost. Of course the objections to increasing the width of way, on the score of expense, become less as the increase to be made is diminished; the *main reason* in my view for abiding by the 4 feet $8\frac{1}{2}$ inch gauge in this country is, that it has been greatly adopted, and that there are no very substantial grounds for altering it. I have never heard any one, whose opinion I should esteem of great value from their experience of the working of locomotives on railways, wish for more than a few inches of additional width, five or six inches at the utmost; and even as to this increase, just in proportion as the parties had had much to do with the working of the locomotives on railways, so in the same proportion did they esteem even it to be of minor importance.

Perhaps, if railways were just commencing in this country, an addition of a few inches, five or six inches at the most, might be made; but the advantage to be gained by making it now, in my opinion, would in no manner compensate the evil that will arise from a variety of gauges in the same country.

Impressed with the importance of having other opinions on this subject than my own, I addressed a letter to two of the largest manufacturers of locomotives in this country, requesting from them to know what in their opinion were the practical disadvantages of the 4 feet $8\frac{1}{2}$ inches gauge as affecting the manufacturer.

The opinions of both these parties in my view are peculiarly valuable, for they were not only amongst the earliest locomotive manufacturers, but have also had much more experience as to the working of their engines on railways than any other manufacturers I know; and without this latter kind of experience, manufacturers are, to a certain extent, only theorists, as to the question in hand.

Their answers are below.

"Liverpool, Sept. 29th, 1838.

"Dear Sir,—In reply to your letter of the 27th inst. referring to the question of the right gauge, which at this time is so much agitated,

"I beg to state that though we do not labour absolutely under great difficulties, in consequence of the want of breadth, yet there is no doubt an addition to the present width (4 feet $8\frac{1}{2}$ in.) of a few inches would enable us to make a more perfect engine. The addition of 6 inches would be ample, and I consider any thing beyond that would tend to increase the difficulties beyond what we now experience, rather than otherwise.

"Yours truly,

(Signed) "Edward Bury.

"John Hawkshaw, Esq."

"London, Oct. 1, 1838.

"Mr. John Hawkshaw.

'SIR,—The extent of inconvenience we experience in the construction of locomotive engines of moderate power (say 14 inch cylinders (for a gauge of 4 feet $8\frac{1}{2}$ inches, is very small indeed. In our early engines an additional width of 3 or 4 inches would have facilitated the arrangement of the working gear and eccentrics; but this has since been simplified, and our latest arrangement of those parts leave scarcely this small increase of width to be wished for.

"The construction of engines for Russia for *a six feet* gauge, leads us to believe that a considerable increase of expense is attendant upon increased width; more especially if the power of the engine is considered to bear any relation to the width of the gauge. If the power or dimensions of the engine be kept the same, the additional expense consequent upon increase of gauge will not be very considerable.

"We are, Sir, &c.,

(Signed) "ROBERT STEPHENSON & Co."

With respect to Mr. Bury, it may be observed, that if any manufacturer in England has felt inconvenience from the 4 feet $8\frac{1}{2}$ inch guage, he must have done so; for, from the peculiar construction of his engines, it is a principle with him to use inside bearings only, which necessarily leave less room for the working gear than when outside bearings are used.

BRIDGE AT MAIDENHEAD.

I have carefully inspected this bridge, and find that at the crown of the eastern arch, and for 12 or 14 feet on each side of it, there is a separation between the first, second, and third rings of whole bricks, counting from the soffit of the arch; these separations generally are about half an inch wide, and extend three or four yards each way from the crown of the arch: the dislocation appears to be less towards the interior, for on making a hole quite through the brickwork in the centre of the arch, it was found that there was a separation only between the second and third ring of whole bricks, but this separation was about an inch in width.

There is nothing any where that I could perceive like crushing of the bricks, or dislocation in direction of the thrust.

I think it probable, therefore, that if a few iron bolts were put through the arch, so as to prevent any further separation, and the crown of the arch loaded with additional weight, that the bridge *might* stand, and perhaps be quite strong enough for any thing that ever may be required of it. But I cannot say that I should advise such an experiment to be made on such a structure, especially as putting its stability beyond all question will not be a very serious matter.

I should recommend, therefore, that from 25 to 30 feet of the crown of the eastern arch be taken out, (the precise quantity will be seen as the arch is opened,) and replaced with stone, the facing of the elevation may still be of brick, so as not to destroy the appearance of the bridge. The stone will give greater weight to the crown of the arch, which I think is wanted; and I should also recommend an additional weight to be placed on the crown of the western arch: a couple of courses of 8 or 9 inch landings would do; for I find difficulty in accounting for the appearances presented, otherwise than on the supposition, that the haunches of the arches have had more than their full share of load; and at all events, I am of opinion that some additional weight on the crown of both arches will be of service, and will add to the general stability of the structure.

(To be continued.)

Genesee Valley Canal—Report of the Canal Board.

Continued from page 256.

It is not perceived that the proposed substitution of composite for stone locks will materially "impair the usefulness" of the canal. The transit of boats in either case will be equally cheap and expeditious, and the necessary annual repairs can be made with equal facility. At the end of the twelve years, when the timber portion of the lock is to be replaced, the work can be completed in a short time, and before the opening of navigation in the spring. It may possibly occur, however, that during the latter period of the existence of a wooden chamber, repairs would be more frequent, and at times might occasion some interruption to the navigation—and it may be proper also to add, that the expense of replacing the timber from time to time will gradually increase with the gradual advance in the price of lumber.

It is doubtless desirable that all our public works should be constructed in a manner as solid and durable as may be consistent with the permanent interests of the State; but upon a canal so costly, in proportion to its immediate revenues, as the present, it is more desirable to exercise a judicious economy, which will accomplish all the public objects sought by the completion of the work, without burthening the Treasury with a great and unnecessary outlay in the first instance. The fiscal interests of the State may be promoted by sustaining hereafter some additional expense in maintaining the present canal, rather than to incur an immediate and certain loss of capital, with its consequent loss of interest, by expending more money in constructing the work in the first instance, than the exigencies of the trade will require.

By a farther examination of the particulars of the work in question, the Board have perceived that the plan originally recommended by the Chief Engineer, for crossing the Genesee river at Mount Morris, has been materially varied. By that plan it was proposed to pass boats through the mill-pond above the dam, which affords a deep and safe navigation, and capable of being adapted with little expense to the purposes of the canal. The Engineer was directed, however, during the last season to scuttle the dam and build an aqueduct over the river, at an elevation of 22 feet above its surface. The estimated cost of the aqueduct, exclusive of the damages for scuttling the dam, is $122,660.

One of the reasons assigned for building the aqueduct, was the apprehension that the freshets of the river might occasionally render the mill-pond impassable for boats. But the interruption which would thus be experienced in passing the river could only be temporary, and would not exceed five or six days in a year—and any apprehension in this respect are fully counterbalanced by the danger that the aqueduct may be swept away by some of the heavy inundations to which it would be subject. The breaking up of the Genesee river, carrying with it large masses of ice, must be attended with hazard, but when burthened, as it frequently is, with floating trees and drift wood, it would greatly endanger any structure which should impede its course; and it need hardly be stated, that the destruction of the aqueduct would occasion much more serious interruption to the trade of the canal, than would ever be realized from all the embarrassments which can be anticipated in passing through the pond.

It should however, be observed, that if the aqueduct could be maintained, it would furnish a more perfect and convenient navigation than to cross in a pond above the dam; and it would also disconnect the canal

from the hydraulic power now drawing its water from the pond. But the Board entertaining doubts of the security of the aqueduct, and considering the difference in expense and other circumstances, they recommend the abandonment of the aqueduct.

In proposing those changes in the plan of constructing this canal, it should, however, be stated, that it has now become somewhat difficult to carry them into execution. The 10 stone locks between Rochester and Mount Morris, as is above stated, are so far completed that they cannot now be changed with advantage. Of the remaining 104 locks, 78 are already under contract—but it is believed that not much progress has been made in their construction. The aqueduct at Mount Morris has also been put under contract, and some expense has been incurred in preparing the foundations of the pier.

The hope is, however, entertained that if authority shall be promptly given by the Legislature to settle with the contractors, it may be accomplished upon reasonable terms. Important savings may therefore yet be made, by changing the plan in the particulars above suggested. But the work is now in rapid progress, and whatever changes are to be made should be commenced immediately. So pressing, in the opinion of the Board, is the exigency of the case, that they have felt bound to lose no time in communicating the facts to the Legislature; and they have therefore answered the resolution of the Assembly, without waiting to investigate more minutely those particular details of the work, which might have enabled them to state whether any other alterations than those above suggested could be made in the plan of the canal, which would "lessen its cost without impairing its usefulness."

All of which is respectfully submitted.

SAMUEL B. RUGGLES,
W. C. BOUCK,
JONAS EARLL, Jun'r.
BATES COOKE,
JACOB HAIGHT,
O. L. HOLLEY,
J. C. SPENCER.

Albany, April 15, 1839.

CHEMICAL AND OPTICAL DISCOVERY.—At the last sitting of the Academy of Sciences, M. Arago announced one of the most important discoveries in the fine arts that have distinguished the present century, the author of which has already acquired universal reputation by his miraculous diorama—M. Daguerre. It is well known that certain chemical substances, such as chloride of silver, have the property of changing their color by the mere contact of light; and it is by a combination of this nature that M. Daguerre has succeeded in fixing upon paper prepared with it the rays that are directed on the table of the camera obscura, and rendering the optical tableau permanent. The exact representation of whatever objects this instrument is directed to is, as every body is aware, thrown down with vivid colors upon the white prepared to receive them, and the rays of light that are thus reflected have the power of acting in the way above alluded on chloride of silver, or certain preparations of it. In this manner an exact representation of light and shade of whatever object may be wished to be viewed, is obtained with the precise accuracy of nature herself, and it is stated to have all the softness of a fine aquatint engraving. M.

Daguerre had made this discovery some years ago, but he had not succeeded in making the alteration of color permanent on the chemical substance. This main desideratum he has now accomplished, and in this manner has been able, among other instances, to make a permanent chemical representation of the Louvre, taken from the Pont des Arts. M. Arago, in commenting upon this most extraordinary discovery, observed, that a patent would be by no means able to preserve the rights of the discoverer sufficiently to reward him for his efforts; and he therefore urged the propriety of an application being made to the legislature for a grant of public money as a recompense. M. Biot, on the same occasion, compared M. Daguerre's discovery to the retina of the eye, the objects being represented on one and the other surface with almost equal accuracy.

What is the secret of the invention? What is the substance endowed with such astonishing sensibility to the rays of light, that it not only penetrates itself with them, but preserves their impression; performs at once the function of the eye and of the optic nerve—the material instrument of sensation, and the sensation itself. In good sooth we know nothing about it. Figure to yourself, says a Parisian contemporary, a mirror which, after having received your image, gives you back your portrait, indelible as a picture, and a much more exact resemblance. Such is the miracle invented by M. Daguerre. His pictures do not prodnce color, but only outline, the lights and shadows of the model. They are not paintings, they are drawings: but drawings pushed to a degree of perfection that art never can reach.

One has heard of writing by steam, but *drawing by sunshine* (or moonshine) is a novelty for which the world is indebted to M. Daguerre, of Paris, the diorama painter. M. Arago and M. Biot, who have made reports to the Academy of Sciences of the effects of M. Daguerre's discovery, have given up all attempts to define its causes. The complaisance of the inventor has permitted us to see these *chefs d'œuvre*, where nature has delineated herself. At every picture placed before our eyes we were in admiration. What perfection of outline—what effects of *chiaro oscura*—what delicacy—what finish! But how can we be assured that this is not the work of a clever draughtsman? As a sufficient answer, M. Dague rre puts a magnifying glass in our hand. We then see the minutest folds of drapery, the lines of a landscape, invisible to the naked eye. In the mass of buildings, accessories of all kinds, imperceptible accidents, of which the view of Paris from the Pont des Arts is composed, we distinguish the smallest details, we count the stones of the pavement, we see the moisture produced by rain, we read the sign of a shop. Every thread of the luminous tissue has passed from the object to the surface retaining it. The impression of the image takes place with greater or less rapidity, according to the intensity of the light; it is produced quicker at noon than in the morning or evening, in a summer than in a winter. M. Daguerre has hitherto made his experiments only in Paris; and in the most favorable circumstances they have always been too slow to obtain complete results, except on still or inanimate nature. Motion escapes him, or leaves only vague and uncertain traces. It may be presumed that the sun of Africa would give him instantaneous images of natural objects in full life and action.—*Paris Constitutional.*

Railroads—Many persons have a dread of travelling on Railroads, and in steam boats, being impressed with the idea that they will be dashed to

atoms against the earth, by running off the track, or be blown 'sky high,' by the explosion of a boiler. Scarcely any fear could have less foundation in reason. These are the safest of all modes of travelling; and considering the vast multitude that are conveyed through the land, the small number of accidents is wonderful. We have no general report of deaths on Railroads in this country, but returns from ten Railroads in England, show more than forty millions of passengers have been carried in seven years, and that of that number and in that period of time, only ten persons were killed by accidents, and but four of these were passengers.

We think it a great error in public prints to record every little accident which occurs in steam travelling. For the purpose of 'getting up' exciting news, the most trifling incident is ushered forth with some marvellous caption, and embellished, magnified, and exaggerated to some dreadful occurrence, and we are thus shocked with 'narrow escapes,' 'serious accidents,' 'shocking calamities,' and 'dreadful loss of life.' Such alarming phrases and amplified accounts tend to impress the timid and unthinking with the most painful dread, and through the whole course of a journey they suffer intense misery. It is time the public journals had reformed this practice—for they are inflicting, by these aggravated details, a heavy amount of misery on travellers. There is scarcely any other mode of conveyance upon main routes than by steam, and it is wanton cruelty to fill the hearts of such multitudes, who are forced to adopt such conveyance with unecessary fears.—*Delaware State Jour.*

Action for Damage by the Railroad.—A case of general interest so far as it involves the general question of liability of the corporation for damage sustained on their road, or through the negligence of their agents, was tried last week in the Baltimore county court. It was a suit brought by Philip Uhler, against the Baltimore and Ohio Railroad Company, for damages in consequence of injury done to the plaiutifs wife, who, in crossing Howard street in September, 1837, was struck down by an empty railroad car, brought there for the purpose of being loaded, and so much injured thereby as to result finally in her death.—The damage was laid at $20,000. The injury, it appeared, was the result of an accident, which, not being likely to be forseen, was hardly to be guarded against. And so far as may be learned from a report of the testimony, the unfortunate collision which resulted in such fatal injury to the wife of the plaintiff, did not occur through any direct agency or remissness of duty on the part of the Railroad Company or its agents.

The car had been placed in a position on the Howard street Railroad and there secured. It was removed thence a small distance by persons not in the employ of the Company, for the purpose of greater facility in loading. The removal brought it upon the verge of an inclined plane; and the car unexpectedly and insensibly, as it were, acquired an impetus, that put it beyond the control of those who had effectd the removal, and carried it with a rapid motion into the plane at the intersection of Howard and Lexington streets, where the deceased was passing at the instant, and where the injury was done. From these and other "mitigating" circumstances in the case, the jury gave a verdict of $500 for the plaintiff.—*Baltimore paper.*

The Brunswick and Florida Railroad.—The first meeting of the Stock holders of this company upon the 6th inst, was numerously attended at Thomasville. About two hundred were present, representing stock to the

amount of a half million of dollars. The first instalment of five per cent. was paid up with great spirit, and much urgency that the work should immediately proceed to its accomplishment, of the great importance and success of which, no one could entertain a doubt. Of the amount of stock not represented, many of the holders had not received notice of the meetng, and others, of the western counties, were at such distances that they could not attend. The collection of their assessments is now going on, and we shall soon be able to announce its complete payment. The election of the officers of the Company is such as to give the public still further confidence in the good conduct and speedy completion of this great work. Their names are as follows:

THOMAS BUTLER KING, of Brunswick, President.

General James Hamilton, of S. C.
General Jones, of Stewart Co.
Colonel Jones, of Lowndes Co.
Rev. Mr. James, of Lee Co.
Col. T. E. Blackshear, of Lee Co.
Duncan Ray, Esq. of Lee Co.
} *Directors.*

T. J. Johnson, of Thomas Co. *Treasurer.*
A. L. King, of Brunswick, *Secretary.*
MONCURE ROBINSON, of Philadelphia, Chief Engineer.
William Parker, of Boston, Principal Assistant Engineer.

New York and Erie Railroad.

At a meeting of citizens held pursuant to public notice, at the Merchants Exchange, on Tuesday, the 16th April, W. W. Todd was appointed President, and James Lee, Secretary.

The following resolutions were unanimously passed: —

Resolved, That the New York and Erie Railroad, which will connect the commerce of the Great West with that of the City of New York, is calculated to foster the best interests of our citizens, and to develope the resources of thisCommercial Emporium,—while it will augment the wealth and power of this State.

Resolved, That the Company to whom has been committed this great Enterprise, having signified that they cannot, with their own means, carry forward to completion, this work with such rapidity as its importance demands,—and that they are ready to surrender their charter upon just and equitable terms, whenever the State shall assume the construction of this Railroad: —Therefore

Resolved, That the unrivalled extent of the work, stretching from the Atlantic to the Western frontier, and yet lying wholly within the limits of this State—the magnitude of its commercial capabilities—the rapid transmission of the public mail, and of the military forces and munitions of the republic, and the strength which it adds to the bonds of the Union,—entitle this work to be considered as of such vast importance as to be adopted by the State, and to be carried onward with the utmost speed.

Resolved, That the delay in constructing this work—is to be fairly estimated at an annual loss in money, of millions of dollars to this community and the southern tier of counties,—and that the completion of successful rival enterprizes, which are promoted by our supineness, is dangerous to our trade and commerce—and requires the immediate action of all by whom the pre-eminence of our commercial position is justly valued.

Resolved, In the opinion of this meeting, that there is nothing in the fiscal condition of this great State to require any pause in carrying into effect this most important branch of Internal Improvement through the Southern tier of Counties, hitherto deprived of the fostering aid of the Government, and at a cost which, from the best sources of information, will not exceed from seven to eight millions of dollars, to be expended in the course of the next five years.

Resolved, That the Representatives of this City in the Senate and Assembly of the State, should be furnished with a copy of these resolutions, signed by the officers of this meeting, with a request that they would present the same and enforce the views contained in them, in the Legislative bodies to which they respectively belong.

W. W. Todd, Chairman.

James Lee, Secretary.

Rail Road Engine.—The following grand description of this new and mighty animal, that is now careering through our land, is extracted from the Quarterly Review:—

There are no doubt many of our readers who have yet to receive those common place impressions which are made upon the mind of the traveller, when for the first time he sees and hears the ENGINE, as from a point in advance on the railway it retrogradingly approaches in order to be looked on to a train composed, as on the London and Liverpool line, of eighteen or twenty huge cars, besides private carriages on runners, caravans full of horses, wagons of heavy goods, &c., &c., &c. The immense weight, upwards of 80 tons to be transported at such a pace to such a distance, when compared with the slight neat outline of the ENGINE, the circumference of whose black funnel would not twice go round the neck of an antelope, and whose bright copper boiler would not twice equal the girth or barrel of a race horse, induces the stranger to apprehend for a moment that the approaching power must prove totally inadequate to its task; but the tearing and deafening noise with which this noble animal of man's creation advances to his work satisfactorily demonstrates that it has itself no fear, but comes as a bridegroom out of his chamber, rejoicing like a giant to run his course.

If the character of this noble creature be considered for a moment with that of a horse, the comparison is curious. With sufficient coals and water in his manger, which, it must be obeerved, whenever he travels he takes with him, he can, if the aggregate of his day's work be considered, carry every day for years at the rate of sixteen miles an hour, the weight of an army of 21,404 men, of 10 stone 10 lbs. each; whereas a good horse could not at the same pace and for the same distance continue to carry every day more than one such man. For a distance of eighty miles he can carry the weight of 2788 men at a rate (sixteen miles an hour,) that neither the hare, the antelope, nor the race horse could keep up with him.

No journey ever tires him; he is never heard to grumble or hiss but for want of work; the faster he goes the more ravenously he feeds; and for two years he can thus travel without medicine or surgery. It requires, however, 2000*l.* a year to support him. We might to these observations add a graver reflection, that, as by the invention of the telescope man has extended his vision beyond that of the Eagle, so by the invention of the locomotive engine, he has now surpassed in speed every quadruped on the globe. We will, however, detain the engine

no longer, but for a few moments will, with our readers, accompany the train with which it has now started.

The dashing at full steam speed into the small black orifices of the tunnel—the midnight darkness that prevails there—the flashes of light that occasionally denote there air shafts, the sudden return to the joyous sunshine of the world—the figures of the company's green servants, who as the train whisks past them, stand all in the same attitude motionless as statues, with white flags, (the emblems of safety,) in their extended hands —the occasional shrill, plaintive whistle or scream, by which the engine, whenever necessary, scares the workmen from the rails—the meteor like meeting of a return train, of which *in transitu* no more is seen than of the coloured figures on one of the long stripes of painted glass; which, after slow exhibition before children are by the showman rapidly drawn across the lens of his magic lantern;—all these sensations unite in making the traveller practically sensible of the astonishing velocity with which not only he and his fellow-passengers, each seated in his arm chair, but heavy goods can now be transported.

From the Newark Daily Advertiser.

The Morris and Essex Rail Road has adopted a new improvement recently invented and patented by Stephan Vail, Esq., of Morristown, for the purpose of supplying the Locomotives with water. By a simple and substantial fixture, the engine is made to work a pump at the depot, which fills the boilers from a well, while the firemen are taking in wood, without the intervention of any other agency than the steam, which would otherwise be "blown off." The adjustment is made in a moment by the engineer. This ingenious and economical contrivance not only saves the expenses of a hand at each watering place, but supersedes the necessity of the usual cisterns, which are liable to freeze in winter, and furnishes water of the same temperature through all the seasons of the year. Thus is experience and skill constantly increasing the value and perfectness of this wonderful instrument of human power and ingenuity, now almost instinct with rational life.

The trip to Morristown is now reduced to a little more than an hour and a half by the entreprise of this useful company; and we need scarcely say to our readers in this vicinity that it is among the most attractive and agreable excursions for parties of pleasure in the vicinity of the commercial metropolis. Passengers may now leave New-York at 9, and Newark at 10 A. M., reach Morrisville before 12, and have abundant time for dinner or social intercourse, and be returned early in the afternoon without the slightest inconvenience or fatigue—traversing, in the meantime a highly picturesque country, more remarkably diversified than any rail-road route within our observation.

The cars wind their way through a mountainous region for near 20 miles, in such a way as to afford a succession of rich and constantly varied views, embracing almost every variety and attribute of grand and beautiful scenery. There is nothing like monotony on this route. We passed over the road yesterday, and never saw the country more verdant or beautiful. The company have just placed a new eight-wheel car on the line, which is calculated to accommodate 90 passengers. We advise the reader, in search of health or pleasure, to give it a trial.

Ohio Rail Road Meeting.—A general meeting of the stockholders of the Baltimore and Ohio Rail Road Company was held yesterday morning in conformity with public notice, for the purpose of considering the act of Maryland, passed at the late session of the Legislature, in reference to this company. The meeting was organized by the appointment of Robert Gilmore, Esq., as chairman, and J. J. Atkinson, Esq., as secretary. After the reading of the act by the secretary, Mr. McLane, the President of the Company, explained, in a short address, the reasons which had determined to approve of the act, and which, he believed, would influence the stockholders to come to the same conclusion. He adverted, in his accustomed lucid style, to the advantageous position in which the company was placed by the provisions of the present act, when compared with its trammelled condition under the practicable requirements of the act of 1836. The act under consideration rendered the State's subscprition of $3,000,000, available for the operations of the company in its progress westward, and left it to the company to determine when and where the money should be expended. At the conclusion of Mr. McLane's remarks, a resolution was offered by H. W. Evans, Esq., expressive of the acceptance of the act by the stockholders. This resolution was unanimously adopted, and the meeting then adjourned *sine die.*—*Baltimore paper.*

The Portage Rail Road.—Like every other portion of the public works under the management of the new officers, the Alleghany rail road, is doing a handsome business. We have seen a statement of the number of cars passed over it during the present and two previous springs up to the 30th of April in each year, and is as follows:—

1837.	From opening of the road to the 30th April, there passed,	. . . . .	6,413	cars.
1838.	do.	do.	7,423	"
		Increase 1010 cars.		
1839.	do.	do.	9,724	"
		Increase 2,301 cars.		

And the cars this season average much heavier loads than they carried the previous seasons. It is thought that the expense of the Motive Power department will not exceed that of 1838, and if so the department will be able to pay its own expenses, and leave a balance in favor of the commonwealth.—*Blairsville Record.*

Boston and St. Louis Railroad.—We received this morning a pamphlet, from Boston, entitled "Letters on the subject of a line of Railroads from Boston to the Mississippi." Connected with this is a circular from a committee of the Western Railroad Corporation, requesting information "on the subject of a continuous line of Railroads from Boston to St. Louis, from all persons who are friendly to the internal improvement of the country. The committee consists of Wm. Savage, P. P. F. Degrand, Amasa Walker, E. Copeland, jr., and Henry Cutler.

It is stated that the chain of railroads from Boston to Buffaloe are all graded for more than half the whole distance, and are in rapid progress towards completion.

The largest steamboat on the western waters is said to be the St. Louis of *eleven hundred tons* burthen, and 130 feet long. She has two engines and eight boilers, and runs between St. Louis and New Orleans.—*Annapolas Republican.*